COVID-19 and Personal Protective Equipment (PPE) *at a glance*

Introduction

This at a glance article aims to introduce the reader to personal protective equipment (PPE) provision and explore contemporary guidelines in the context of nursing patients in the United Kingdom (UK) with COVID-19. The current situation is such, that the reader should continue to refer to contemporary guidelines as they are frequently updated as the situation evolves.

COVID-19 is an infectious respiratory disease caused by a novel coronavirus, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) (Public Health England (PHE), 2020a). SARS-CoV-2 virus replicates efficiently in the upper respiratory tract and appears to cause less abrupt onset of symptoms than the common cold, meaning infected individuals carry on usual activities for longer, increasing asymptomatic transmission of infection (Heymann and Shindo, 2020). The virus is primarily transmitted between people though respiratory droplets and contaminated objects; airborne transmission may be possible in specific circumstances where aerosol generating procedures (AGP) are performed, such as suctioning (WHO, 2020a).

The UK has seen widespread transmission of the virus for several weeks with increasing reports of outbreaks in long-term care homes associated with high mortality, highlighting the extreme vulnerability of the elderly in this setting. The introduction of physical distancing measures, such as the cancellations of large gatherings and the closure of educational and public spaces, alongside ‘stay at home’

policies has collectively reduced transmission and the 14-day incidence by 18% since 8 April 2020. The risk of severe disease in the UK is currently considered low to moderate for the general population, but moderate to high for populations with risk factors (>65 years of age and/or those with underlying health conditions – approximately 31% of the European population) depending on the effectiveness of physical distancing and the current level of community transmission (European Centre for Disease Prevention and Control, 2020). Daily situation reports from the WHO demonstrate increasing cases and mortality rates (WHO, 2020b).

The ability to limit the transmission of COVID-19 in the healthcare setting requires infection prevention and control measures, of which PPE is a fundamental element (PHE, 2020b). This is essential to limit acquisition and transmission of the virus to protect health professionals, the patients they care for and the wider community. Protecting health professionals not only limits disease spread, but also ensures there are adequate numbers of staff to cope with the inevitable increasing demands for healthcare services, in the coming weeks and months ahead.

Sufficient supply of PPE is essential to meet increased demand during the COVID-19 pandemic; the government has sought to put measures in place to improve supply chains and provisions of PPE including:

- HSE and local authorities to fast track product safety assessment processes and prioritise this activity
- Allowing PPE lacking a CE (conformite Europeene) safety mark onto the market provided it meets essential safety requirements (GOV.UK, 2020)

- A public call out for organisations that can manufacture and supply testing consumables, equipment and laboratory PPE (PHE, 2020c)

When used correctly, PPE such as gloves, aprons, eye protection, masks and gowns function as a physical barrier to the transmission of infectious particles present in bodily fluids; PPE also protects patients from transmission via contaminated hands or clothing of healthcare staff (Brown, Munro and Rogers, 2019).

UK wide guidance on PPE for the care of patients with suspected or confirmed COVID-19 was updated on 2nd April 2020, issued jointly by PHE, NHS England and other key stakeholders across the devolved nations (PHE, 2020d).

It is recognised that there are risks to both staff and patients with respect to the inappropriate use of PPE namely, cross contamination and spread of infection. Boivin (2015) highlighted the reasons leading to inappropriate use include; lack of awareness of importance of PPE, time constraints for donning/doffing, lack of realisation in the importance of technique for proper removal; all of which ultimately relies upon staff being properly educated in the use of PPE.

Concerns regarding the sufficient supply of PPE and the evolving nature of the current pandemic, with many staff working in unfamiliar areas with unfamiliar equipment may serve to further compound issues in relation to inappropriate use of PPE, and the risks this presents.

Due consideration to several issues should be considered in order to mitigate risk; the associated risk with incorrect use of PPE highlights the importance of don and doff in the correct sequence. PHE (2020d) cites the importance of safe ways for working for

health and care workers as having staff trained on donning and doffing PPE and for staff to know what PPE they should wear for each setting and context.

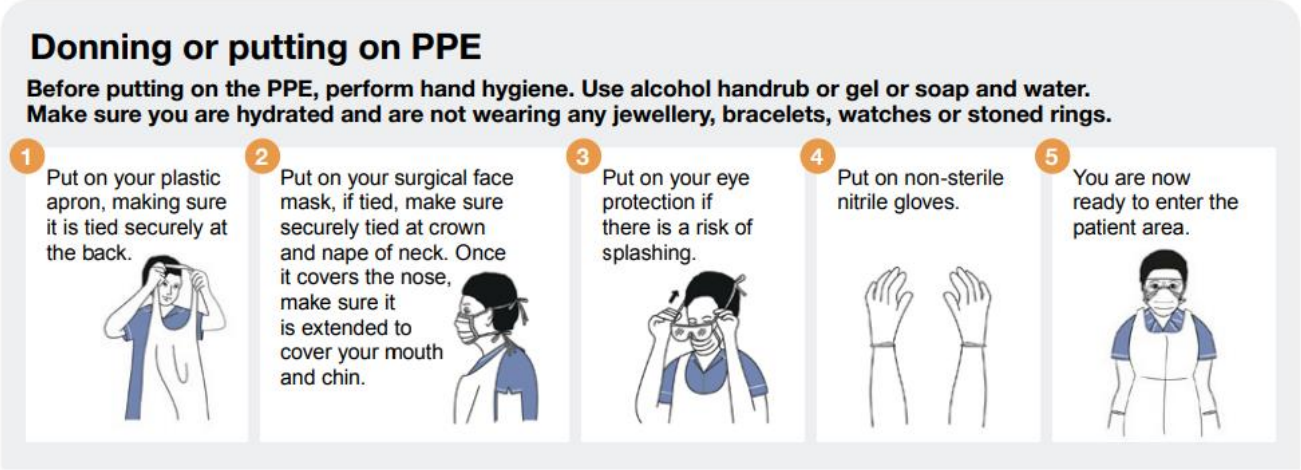
Although there is a recognised standardised order of donning PPE, the most critical time, is in the exact sequence for doff (PHE 2020d).

See figure 1, Guide to donning and doffing standard and AGP PPE for health and social care settings (PHE, 2020e, 2020f)

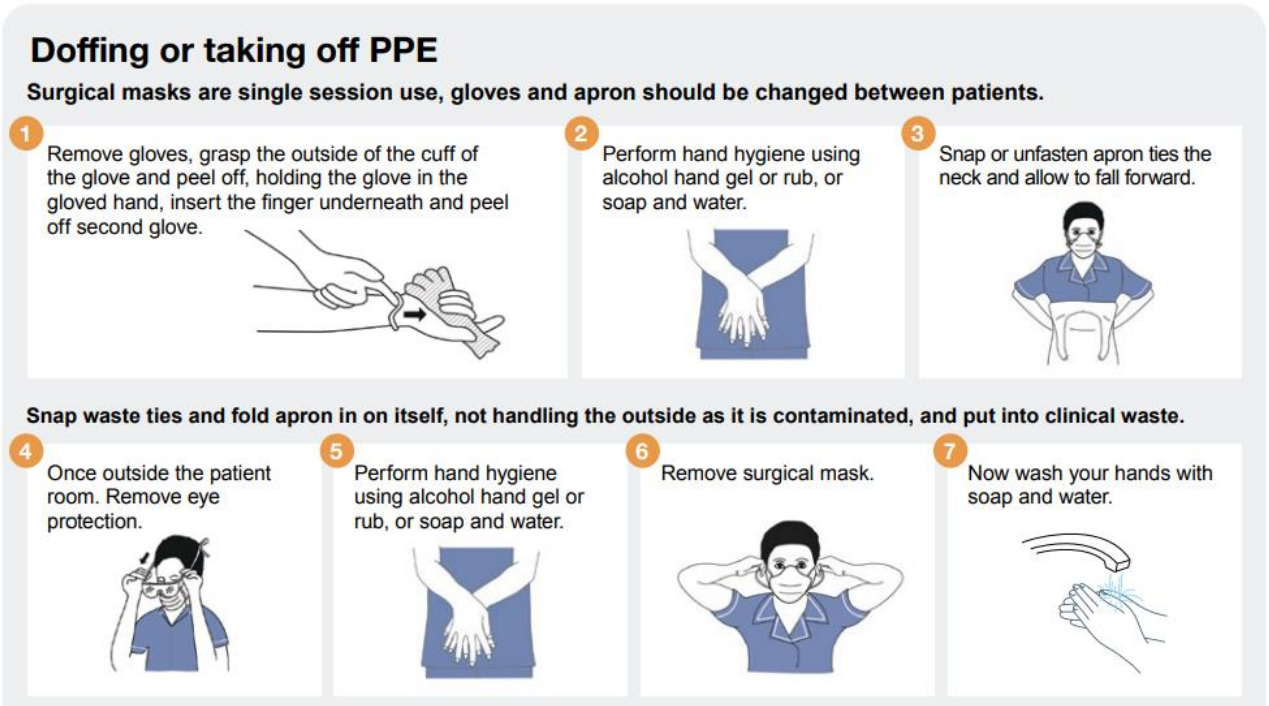
Figure 1: Putting on (donning) and removing (doffing) PPE for standard and AGP's (PHE, 2020e, PHE 2020f)

(BJN editor: images available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/877658/Quick_guide_to_donning_doffing_standard_PPE_health_and_social_care_poster__.pdf) and https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879098/PHE_COVID-19_Donning_gown_version.pdf and https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879105/PHE_COVID-19_Doffing_gown_version.pdf

Standard PPE - donning:



Standard PPE - doffing:



PPE for AGPs - Donning:

Use safe work practices to protect yourself and limit the spread of infection

- keep hands away from face and PPE being worn
- change gloves when torn or heavily contaminated
- limit surfaces touched in the patient environment
- regularly perform hand hygiene
- always clean hands after removing gloves

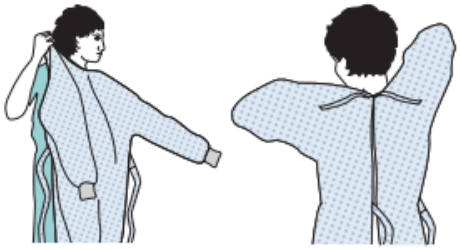
Pre-donning instructions

- ensure healthcare worker hydrated
- tie hair back
- remove jewellery
- check PPE in the correct size is available

Putting on personal protective equipment (PPE). The order for putting on is gown, respirator, eye protection and gloves. This is undertaken outside the patient's room.

Perform hand hygiene before putting on PPE

1 **Put on the long-sleeved fluid repellent disposable gown** - fasten neck ties and waist ties.

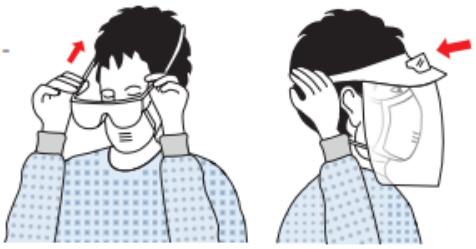


2 **Respirator.** Note: this must be the respirator that you have been fit tested to use. Where goggles or safety spectacles are to be worn with the respirator, these must be worn during the fit test to ensure compatibility

Position the upper straps on the crown of your head, above the ears and the lower strap at the nape of the neck. Ensure that the respirator is flat against your cheeks. With both hands mould the nose piece from the bridge of the nose firmly pressing down both sides of the nose with your fingers until you have a good facial fit. If a good fit cannot be achieved **DO NOT PROCEED**

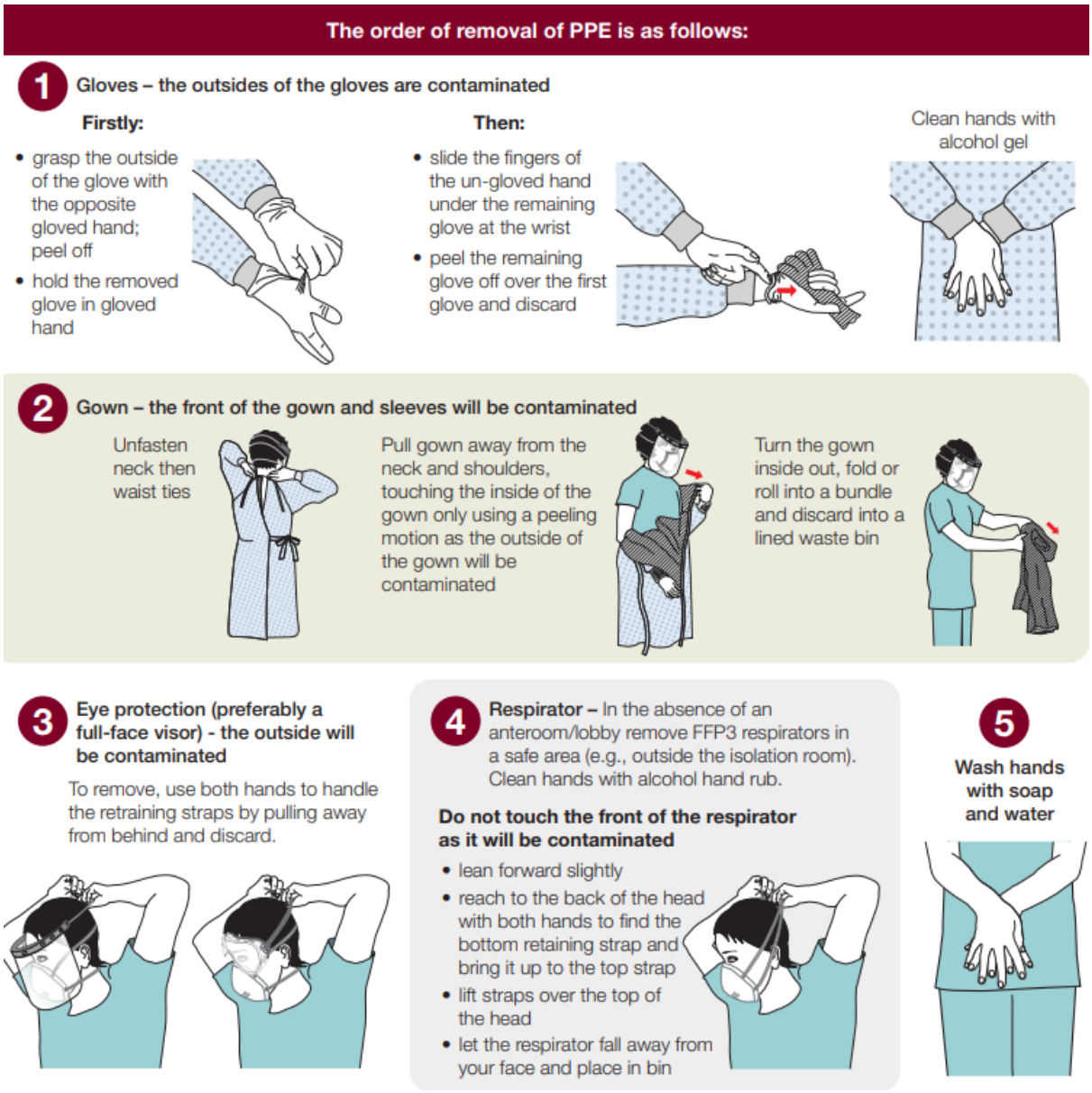
Perform a fit check. The technique for this will differ between different makes of respirator. Instructions for the correct technique are provided by manufacturers and should be followed for fit checking

3 **Eye protection** - Place over face and eyes and adjust the headband to fit



4 **Gloves** - select according to hand size. Ensure cuff of gown covered is covered by the cuff of the glove.

PPE for APGs - Doffing:



Updated guidance from PHE has sought to provide clarity regarding the use of the right PPE for COVID-19 and is in some part, a response to the concerns of healthcare unions and national media coverage regarding the risks associated with insufficient supply of PPE. The updated guidance ensures PPE is used appropriately in order to ensure stock control, and maintain safety of nursing staff, key personnel and patients. The guidance relates solely to considerations for PPE and represents one element of

infection prevention control guidance for COVID-19 and it should therefore be used alongside local policies (PHE, 2020d).

PHE Guidance on COVID-19 PPE – Recommendations for practice:

A summary of the main changes to the previous guidance are identified in Box 2.

- **Enhanced recommendations for a wide range of health and social care contexts**
- **Inclusion of individual and organisational risk assessment at local level to inform PPE use**
- **Recommendation for single sessional (extended) use of SOME PPE items**
- **Re-usable PPE can be used with reference to manufacturers, supplier and local infection control guidance on decontamination**
- **Guidance for when case status is unknown in areas of high-level incidence**
- **Recommendation of patient use of face masks**
- **Emphasising staff are able to risk assess if there is a risk to themselves or the individuals in their PPE decision making on wearing mask**

Box 2: Summary of main changes to previous guidance (PHE, 2020d)

This guidance was updated to reflect the pandemic evolution and the changing level of risk of healthcare exposure to COVID-19. Certain areas of practice may pose a higher risk of transmission (Box 3) with AGPs presenting and increased risk of aerosol transmission. Updated guidance also highlights the need for enhanced protection of patients in vulnerable groups, undergoing social shielding.

A higher risk acute inpatient care area is defined as a clinical environment where AGPs are regularly performed.

Higher risk acute care areas include:

- **intensive care and high dependency care units (ICU or HDU)**
- **emergency department resuscitation areas**
- **wards or clinical areas where AGPs are regularly performed (such as wards with NIV or CPAP)**
- **operating theatres, where AGPs are performed**
- **endoscopy units, where bronchoscopy, upper gastrointestinal or nasoendoscopy are performed**

(PHE, 2020d)

Box 3: Areas of higher risk of transmission

The Chief Medical Officer (CMO), National Medical Director and National Incident Director for COVID-19 (Powis, Whitty and Hopkins, 2020) have summarised the most recent guidelines which are consistent with WHO recommendations, in settings with the highest risk of transmission as follows:

- Any clinician working in a hospital, primary care or community care setting within two metres of a suspected or confirmed coronavirus COVID-19 patient should wear an apron, gloves, surgical (or fluid resistant) face mask and eye protection, based on the risk.

- The guidance recognises that clinicians may wish to wear an apron, gloves, surgical mask and eye protection when assessing patients in any setting, where the risk of COVID-19 is unknown
- In some circumstances PPE, particularly masks and eye protection which is there to protect the health and care worker can be worn for an entire session and does not need to be changed between patients, as long as it is safe to do so.
- When carrying out aerosol generating procedures (AGPs) clinicians should wear a higher level of protective equipment.
- Use of aprons rather than gowns for non-aerosol generating procedures, including guidance to thoroughly wash forearms if there is a risk of exposure to droplets, consistent with the UK policy of bare below the elbows and evidence reviews on the risks of healthcare acquired infections.
- WHO (WHO, 2020c) recommends the use of FFP2 masks but the UK has gone further and recommends the use of FFP3 masks. However, FFP2 have been approved by the WHO and can be used safely if needed –There is good stock of FFP3 masks in the UK.

Regarding this summary by Powis, Whitty and Hopkins (2020), there are several points which require further discussion.

The Health and Safety Executive (HSE, 2020a) have stated that FFP2 and N95 respirators (filtering at least 94% and 95% of airborne particles respectively) offer protection against COVID-19 and may be used if FFP3 respirators are not available (PHE, 2020c). FFP3 respirators filter at least 99% of airborne particles and could therefore be argued to be more effective protection against COVID-19. It should be

noted that the cost of FFP3 masks is higher than FFP2; the stock price of a single FFP face mask varies, with one source retailing FFP2 for £15 and FFP3 for £30 (UKMeds.co.uk, 2020)

Whilst Powis, Whitty and Hopkins (2020) indicate there is sufficient supply, yet there are significant concerns from healthcare unions and front-line staff regarding the current provision at the time of writing (Kinnair, 2020). The newly emerging NHS Nightingale, and planned NHS major field hospitals being built to provide increased capacity for hospitals beds within the UK will increase demand for PPE significantly across the UK, further confounding production and supply chain issues, questioning the assertion that there is sufficient stock of FFP3 within the UK.

Some clarity should also be given to the recommendation regarding the use of surgical face masks; surgical face masks protect against infectious agents transmitted by droplets, such as saliva or secretions exhaled from the upper respiratory tract. If worn by the caregiver, the mask protects the patient, the environment and protects the wearer from splashes of biological fluids. If worn by an infected patient, it prevents contamination to the surrounding environment. Surgical masks may also be equipped with a visor for eye protection. In contrast to FFP3 masks, they do not offer protection against airborne transmission (Sampol, 2020).

Feng *et al* (2020) highlight the argument that surgical face masks provide no effective protection against COVID-19 infection, however, the authors also note that guidance within the UK indicates that whilst there is little evidence of widespread benefit for members of the public, they do play a very important role in hospitals.

Figures 2, 3 and 4 (PHE 2020g) outline the recommended PPE required for various healthcare settings. **Source:** https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control

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Figure 2:

Recommended PPE for healthcare workers by secondary care inpatient clinical setting, NHS and independent sector

Setting	Context	Disposable Gloves	Disposable Plastic Apron	Disposable fluid-resistant gown	Surgical mask	Fluid-resistant (Type IIR) surgical mask	Filtering face piece respirator	Eye/face protection[1]
Acute hospital inpatient and emergency departments, mental health, learning disability, autism, dental and maternity settings	Performing a single aerosol generating procedure[2] on a possible or confirmed case[3] in any setting outside a higher risk acute care area[4]	✓ single use[5]	✗	✓ single use[5]	✗	✗	✓ single use[5]	✓ single use[5]
	Working in a higher risk acute care area[4] with possible or confirmed case(s)[3]	✓ single use[5]	✓ single use[5]	✓ sessional use[6]	✗	✗	✓ sessional use[6]	✓ sessional use[6]
	Working in an inpatient, maternity, radiology area with possible or confirmed case(s)[3] – direct patient care (within 2 metres)	✓ single use[5]	✓ single use[5]	✗	✗	✓ sessional use[6]	✗	✓ sessional use[6]
	Working in an inpatient area with possible or confirmed case(s)[3] (not within 2 metres)	✗	✗	✗	✗	✓ sessional use[6]	✗	✓ risk assess sessional use[6,7]
	Working in an emergency department/acute assessment area with possible or confirmed case(s)[3] – direct patient care (within 2 metres)	✓ single use[5]	✓ single use[5]	✗	✗	✓ sessional use[6]	✗	✓ sessional use[6]
	All individuals transferring possible or confirmed case(s)[3] (within 2 metres)	✓ single use[5]	✓ single use[5]	✗	✗	✓ single or sessional use[5,6]	✗	✓ risk assess single or sessional use[5,6,7]
	Operating theatre with possible or confirmed case(s)[3] – no AGPs[2]	✓ single use[5]	✓ single use[5]	✓ risk assess single use[5,7]	✗	✓ single or sessional use[5,6]	✗	✓ single or sessional use[5,6]
	Labour ward/area – 2nd/3rd stage labour vaginal delivery (no AGPs[2]) – possible or confirmed case[3]	✓ single use[5]	✓ single use[5]	✓ single use[5]	✗	✓ single or sessional use[5,6]	✗	✓ single or sessional use[5,6]
	Inpatient care to any individuals in the extremely vulnerable group undergoing shielding[8]	✓ single use[5]	✓ single use[5]	✗	✓ single use[5]	✗	✗	✗

Figure 3:

Recommended PPE for primary, outpatient and community care by setting, NHS and independent sector

Setting	Context	Disposable Gloves	Disposable Plastic Apron	Disposable fluid-repellent coverall/gown	Surgical mask	Fluid-resistant (Type IIR) surgical mask	Filtering face piece respirator	Eye/face protection[1]
Any setting	Performing an aerosol generating procedure[2] on a possible or confirmed case[3]	✓ single use[4]	✗	✓ single use[4]	✗	✗	✓ single use[4]	✓ single use[4]
Primary care, ambulatory care, and other non emergency outpatient and other clinical settings e.g. optometry, dental, maternity, mental health	Direct patient care – possible or confirmed case(s)[3] (within 2 metres)	✓ single use[4]	✓ single use[4]	✗	✗	✓ single or sessional use[4,5]	✗	✓ single or sessional use[4,5]
	Working in reception/communal area with possible or confirmed case(s)[3] and unable to maintain 2 metres social distance[6]	✗	✗	✗	✗	✓ sessional use[5]	✗	✗
Individuals own home (current place of residence)	Direct care to any member of the household where any member of the household is a possible or confirmed case[3,7]	✓ single use[4]	✓ single use[4]	✗	✗	✓ single or sessional use[4,5]	✗	✓ risk assess single or sessional use[4,5,8]
	Direct care or visit to any individuals in the extremely vulnerable group or where a member of the household is within the extremely vulnerable group undergoing shielding[9]	✓ single use[4]	✓ single use[4]	✗	✓ single use[4]	✗	✗	✗
	Home birth where any member of the household is a possible or confirmed case[3,7]	✓ single use[4]	✓ single use[4]	✓ single use[4]	✗	✓ single or sessional use[4,5]	✗	✓ single or sessional use[4,5]
Community-care home, mental health inpatients and other overnight care facilities e.g. learning disability, hospices, prison healthcare	Facility with possible or confirmed case(s)[3] – and direct resident care (within 2 metres)	✓ single use[4]	✓ single use[4]	✗	✗	✓ sessional use[5]	✗	risk assess sessional use[5,8]
Any setting	Collection of nasopharyngeal swab(s)	✓ single use[4]	✓ single or sessional use[4,5]	✗	✗	✓ single or sessional use[4,5]	✗	✓ single or sessional use[4,5]

Figure 4:

Additional considerations, in addition to standard infection prevention and control precautions,

where there is sustained transmission of COVID-19, taking into account individual risk assessment for this new and emerging pathogen, NHS and independent sector

Setting	Context	Disposable Gloves	Disposable Plastic Apron	Disposable fluid-repellent coverall/ gown	Surgical mask	Fluid-resistant (Type IIR) surgical mask	Filtering face piece respirator	Eye/face protection[1]
Any setting	Direct patient/resident care assessing an individual that is not currently a possible or confirmed case[2] (within 2 metres)	✓ single use[3]	✓ single use[3]	✗	✗	✓ risk assess sessional use[4,5]	✗	✓ risk assess sessional use[4,5]
Any setting	Performing an aerosol generating procedure[6] on an individual that is not currently a possible or confirmed case[2]	✓ single use[3]	✗	✓ single use[3]	✗	✗	✓ single use[3]	✓ single use[3]

PPE during Cardiopulmonary Resuscitation (CPR):

The Resuscitation Council (UK) have indicated that they were not involved with the preparation of PHE guidance on the use of PPE and are awaiting results of an international evidence review process to update their current guidance, published on 27th March 2020 (Resuscitation Council (UK), 2020a). They have provided several

resources for healthcare settings including an adult advanced life support algorithm for COVID-19 patients **(figure 4)** (Resuscitation Council (UK), 2020b).

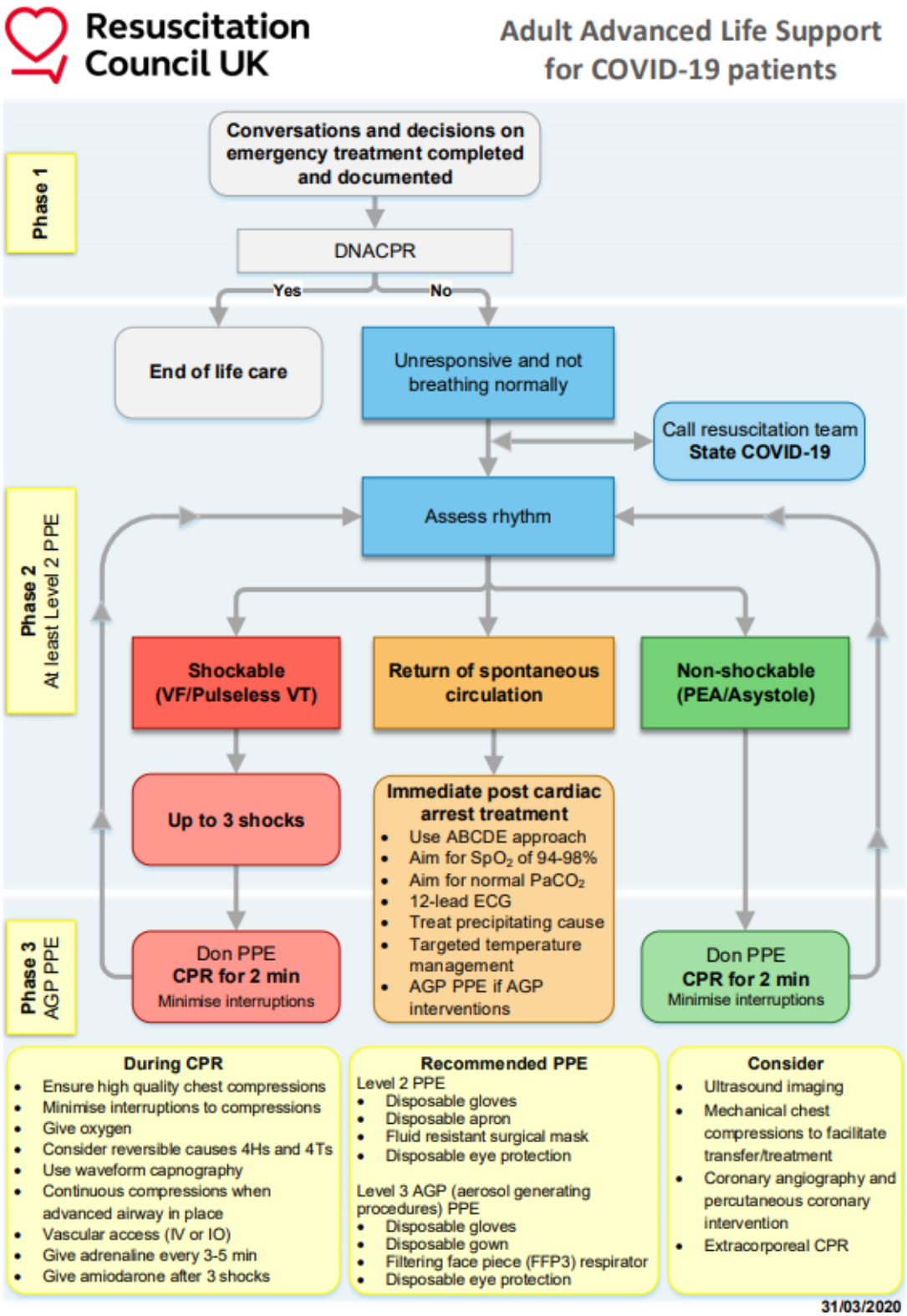

Figure 4: Adult Advanced life support for COVID-19 patients

FFP3 - Fit testing

Fit testing is a method of checking that a specific model and size of tight-fitting facepiece matches the wearers facial features and seals adequately to the wearer's face. (HSE, 2019). HSE have provided guidance on the use of disposable respirators (figure 5 (HSE,2020b).

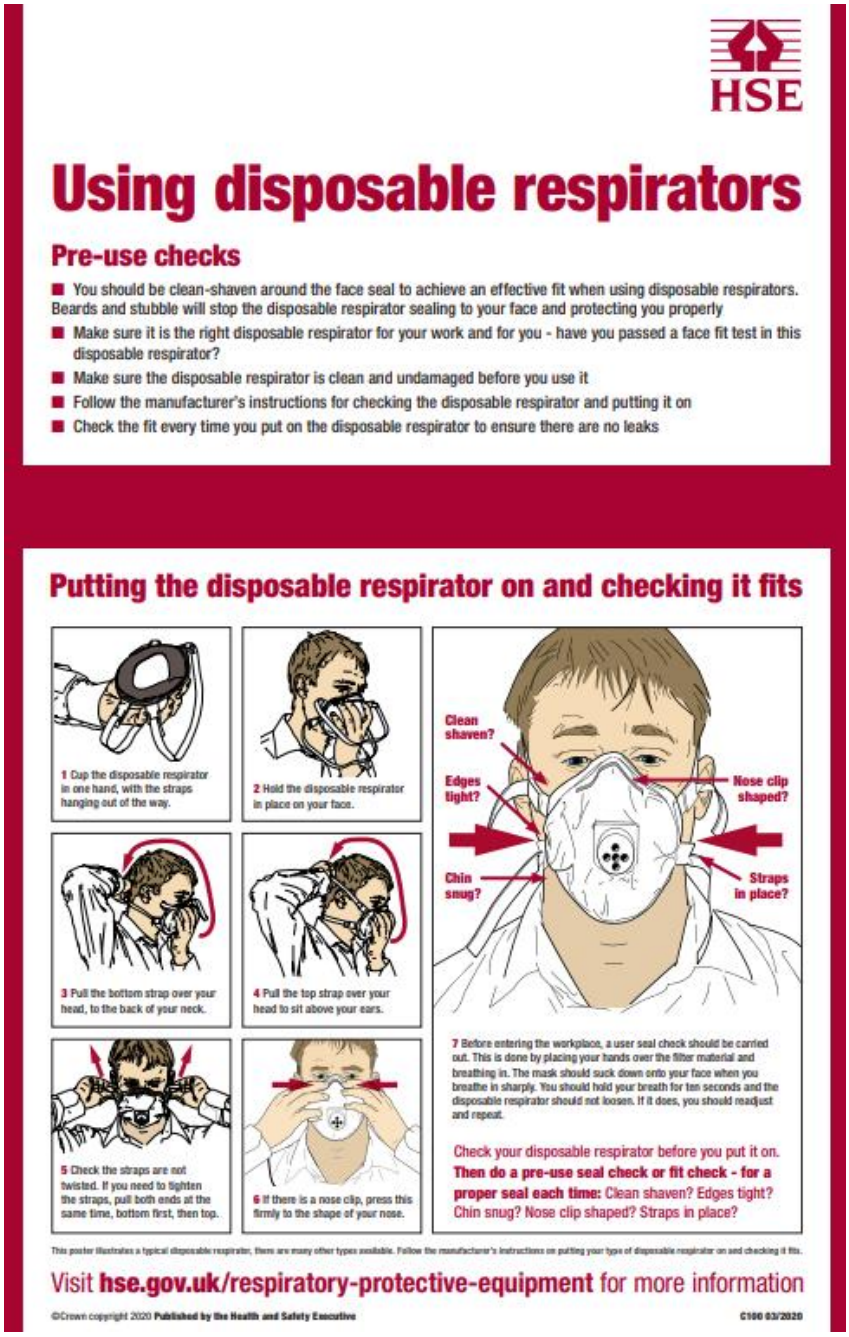

Figure 5: Using disposable respirators (HSE, 2020b)

The Health and Safety Executive (HSE, 2019) state that all staff who are required to wear an FFP3 respirator must be fit tested for the relevant model to ensure an adequate seal or fit (according to the manufacturers' guidance). This must be repeated for each different mask manufacturer and has led to staff being required to be fit tested each time a particular mask went out of stock and was replaced by a different FFP3.

In some instances where staff fail a fit-test on one type of mask, they may pass on a different manufactured mask, therefore, clinical areas are required to keep stock of varying FFP3 for different staff for this reason (PHE, 2020d). Compliance with HSE guidance regarding fit-testing requirements presents practical difficulties during a pandemic, where hundreds of staff require appropriate provision of this equipment.

PHE Summary

The updated guidelines provide an extensive summary of care contexts, sessional use and risk assessment in relation to PPE. Healthcare trusts and all nurses should ensure they are familiar with the recommendations for PPE in their particular area of practice alongside local Infection Prevention and Control Policies.

PHE (2020d) summarises safe ways of working for all health care workers including:

- Staff should be trained on donning and doffing PPE and videos should be available for training
- Staff should know what PPE they should wear for each setting and context
- Staff should have access to the PPE that protects them for the appropriate setting and context
- Gloves and aprons are subject to single use with disposal after each patient or resident contact

- Fluid repellent surgical mask and eye protection can be used for a session of work rather than a single patient or resident contact
- Gowns can be worn for a session of work in higher risk areas
- Hand hygiene should be practiced and extended to exposed forearms, after removing any element of PPE
- Staff should take regular breaks and rest periods

Sessional Use:

It is important to note that there remains a lack of clarity regarding 'sessional' versus 'single use'. Once stock issues in relation to the amount of PPE available for staff were identified, together with a need to potentially cohort patients in a specific area, guidance switched from single use PPE to some equipment being used on a 'sessional' basis. PHE (2020d) does not specifically define the duration of a 'session' instead highlighting manufacturer instructions and local risk assessment of appropriateness of single versus sessional use dependent upon the nature of the activity. They acknowledge that the duration of a session may vary depending upon the task(s) being performed. However, PHE (2020g) refers to a session as a period of time where a healthcare worker is undertaking duties in a specific care setting/exposure environment e.g. on a ward round; providing ongoing care for inpatients. A session ends when the healthcare worker leaves the care setting/exposure environment. Sessional use should always be risk assessed and considered where there are high rates of hospital cases. PPE should be disposed of after each session or earlier if damaged, soiled, or uncomfortable.

Skin Integrity:

The increasing use of wearing of FFP3 has presented an additional risk for some healthcare workers. As Payne (2020) highlights, the prolonged wearing of tight fitting FFP3 masks has caused some healthcare workers to suffer skin damage, frequently around the bridge of the nose, from the constant pressure applied to the skin by the mask. The continuous use of surgical masks also can cause soreness to skin from the straps of the mask resting on the upper ears. This has led to NHS England (2020) issuing an alert detailing how to prevent facial skin damage beneath personal protective equipment. Although advocating the prevention of skin damage, it is recognised that skin breaks may occur and so have offered advice regarding how to manage pressure damaged skin.

Hand Hygiene:

As previously discussed, there is a hierarchy of infection control measures, of which PPE is one aspect. Standard of Infection Control Precautions (SCIPs) remain paramount. This includes single use of gloves and aprons (and their appropriate disposal) with hand hygiene after each patient contact (PHE 2020d).

PHE (2020g) details the best practice handwash using the following steps (Figure 6):

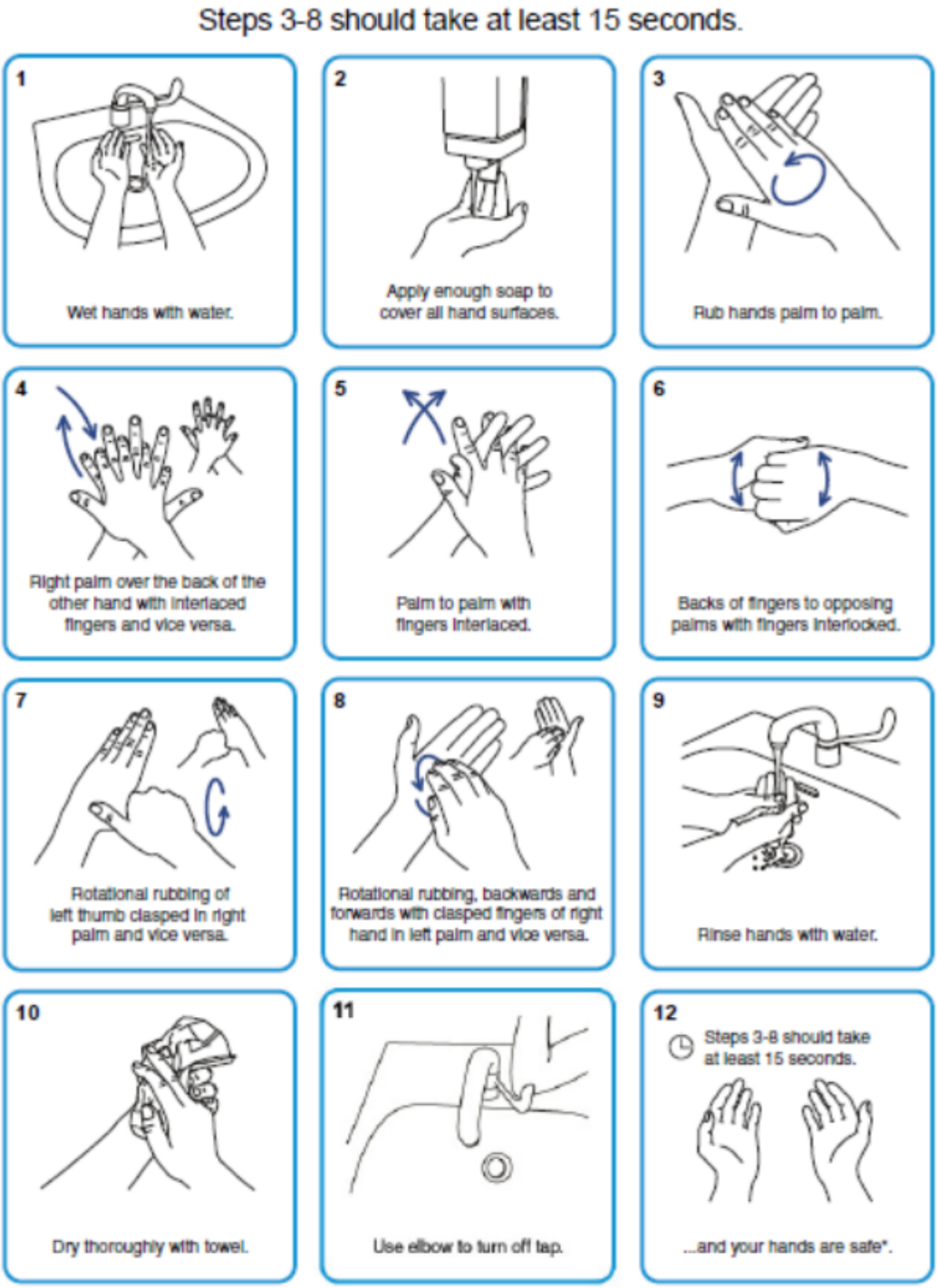

Figure 6: Best Practice: how to handwash BJN editor, available here:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/877530/Best_Practice_hand_wash.pdf

In addition to the above, (PHE, 2020h) in issuing new guidance to NHS teams highlights the need to wash not only the hands, but also thoroughly washing the forearms if there is a risk of exposure to droplets if an apron has been worn.

Conclusion:

Staff working without appropriate PPE, or using PPE inappropriately are at significant risk of infection, leading to potentially increased transmission rates, reduced workforce capacity and ultimately, higher mortality.

Updated guidance seeks to inform nurses of the right PPE to use, depending on their care setting and the procedures undertaken. PHE guidance provides extensive instruction on the use of PPE for standard care or when carrying out an AGPs or working in an area of high risk, during the COVID-19 pandemic. However, updated guidelines in relation to CPR are required considering updated PHE recommendations.

Appropriate and timely provision of effective PPE, alongside strict hand hygiene will contribute to reducing the impact of COVID-19 in both human and economic terms.

Key points

- ***There are concerns about the provision of appropriate PPE for healthcare workers***
- ***PPE guidance in relation to COVID-19 has been updated in order to ensure healthcare professionals use PPE effectively to ensure their own and patient safety, to maximise efficient use of PPE resource***

- ***Nurses should ensure they are familiar with the updated PPE guidelines, relevant to their area of practice, alongside local policy to ensure the appropriate use of PPE and to limit risk of COVID-19 transmission***

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